TU WIEN Informatics

193.026 Methods for Data Generation and Analytics in Medicine and Life Sciences

WS 2024/2025

LV0 – Kick-Off Meeting

Who we are ☺

Martina Marchetti-Deschmann

Georg Ramer

Renata Raidou

Maath Musleh

Aron Kovacs

Christoph Hirber

Silvia Miksch

Allan Hanbury

Pedro Hermosilla

Kees van Berkel

... and many more faces!

Whom should I contact for….

- Course in general → Renata Raidou
- LV-specific topics → the designated lecturer
- UE-specific topics → the designated organizer and/or tutor

- We have a **forum in TUWEL**! But mail is ok too ☺

Tutorium

- **Every Thursday at 12:00-13:00**, on Zoom (see link on TUWEL)!
- Starting on Oct 10 until Dec 5 (aligned with the assignments).
- If nobody shows up the tutor will leave the meeting at 12:15.

Pre-requisites

- Obligatory registration **before October 13!**
- This course is obligatory for the Specialization in Digital Health of the Informatics BSc curriculum (recommended semester: 3rd)
- No pre-requisites from other courses – basics course
- Lectures will be given in English!

General Recommendations

- Bring your laptops/tablets/… and keep notes
- Very diverse audience – some things might be less/more familiar
  - Ask questions!
- Use the Tutorium to get help and learn more
- If something is particularly interesting (or uninteresting) let us know

Useful Links

TISS

TUWEL

Course Goals

Learning outcomes

After successful completion of the course, students:

- **know** the major principles, methods, concepts, and techniques for data generation and analysis in medicine and life sciences, and
- have a **critical understanding** of their theories and principles.

Course Goals

W.r.t. *Data Generation*:

- Describe major anatomical aspects, natural life processes, normal biochemical functioning of the organism (physiology), and abnormal and pathological conditions and their causes (pathology).
- Describe the chemistry of major biomolecules such as nucleic acids, proteins, carbohydrates, lipids, and other metabolites, explain biological structures, and describe structure-function interactions.
- Discuss the **data generated or acquired** relevant to medicine and the life sciences. This includes biomedical, bio-signal, medical image, epidemiological, and public healthcare data.

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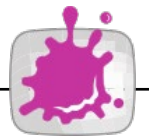
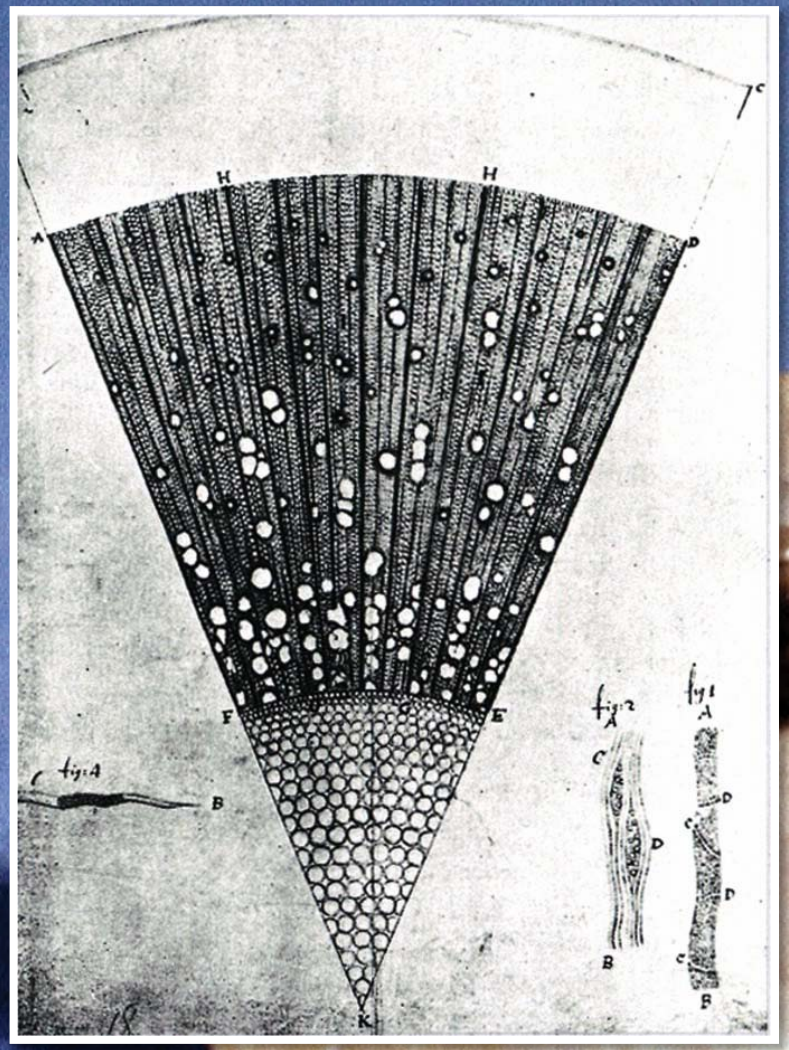
W.r.t. *Analytics*:

- Describe the **key methods required to process and analyze data** for medicine and life sciences. This includes statistics, computer vision, image processing, data visualization, and machine learning.
- Understand the **needs of stakeholders** (e.g., patients, clinicians, bioinformaticians, public health/biology/biochemistry researchers) and apply the above methods to support workflows.

So, what is this course about?



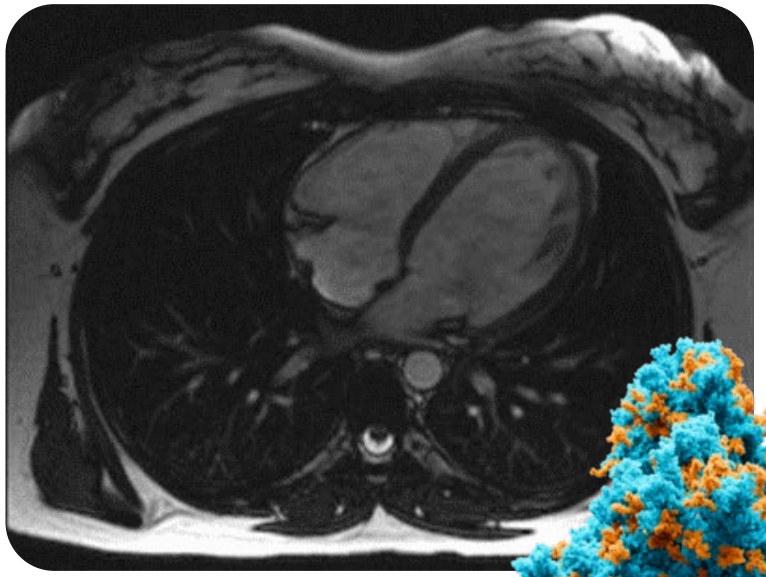
Rembrandt, 1632
The Anatomy Lecture of Dr. Nicolaes Tulp

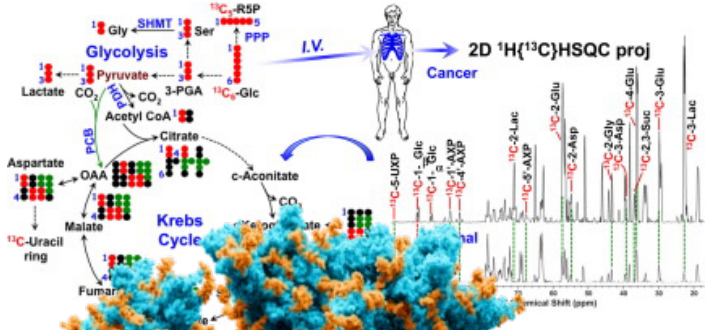


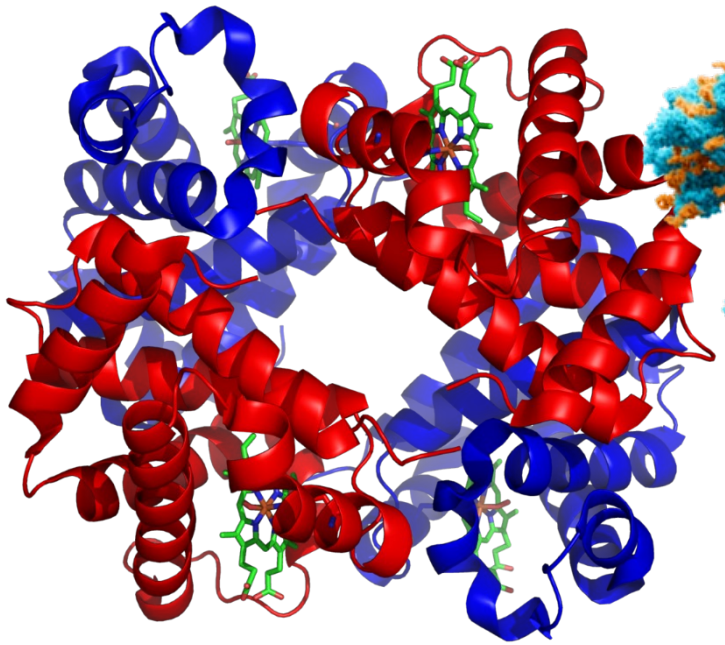
The microscope of Antonie van Leeuwenhoek, 1660s

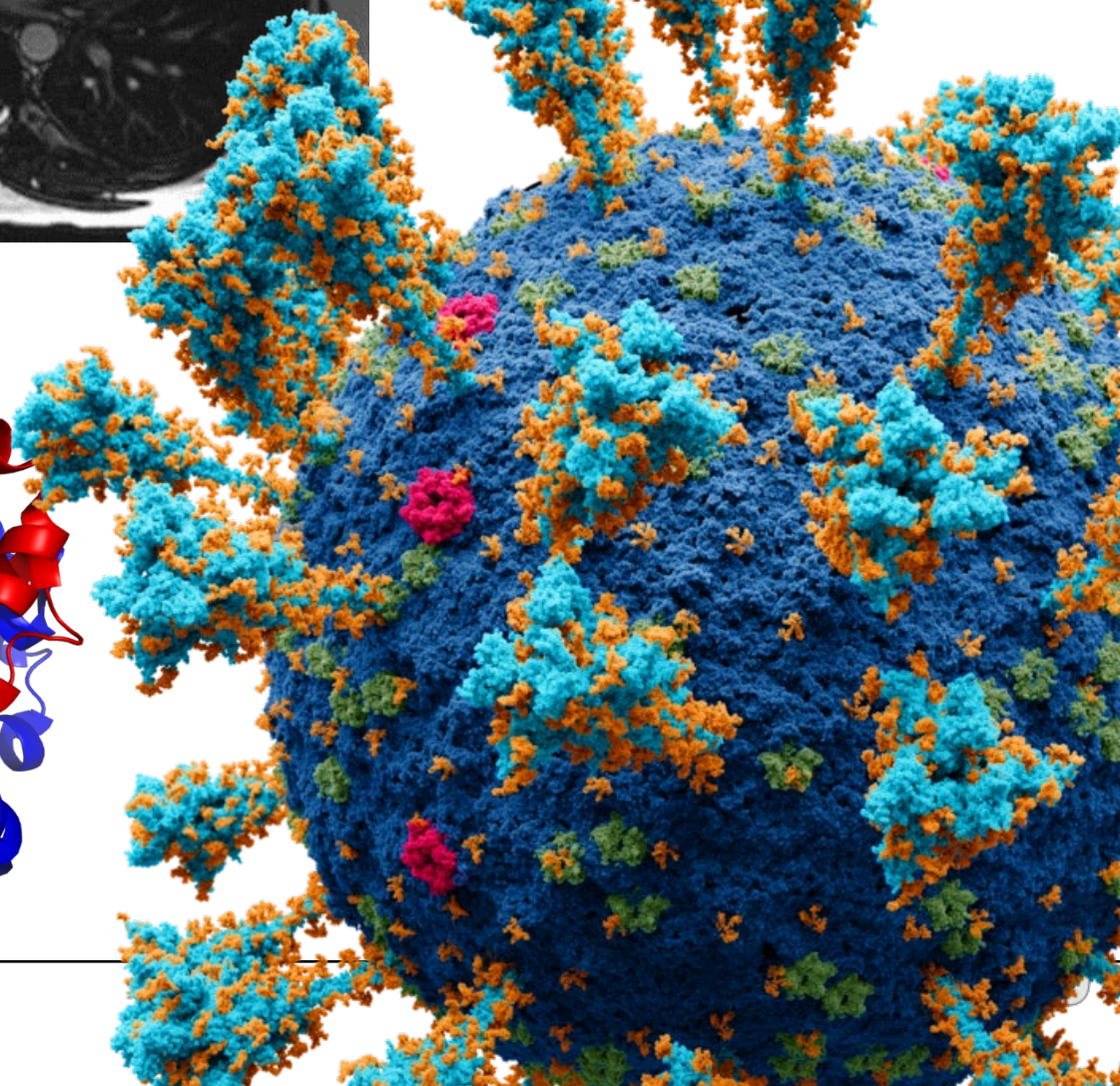
Max Perutz's hemoglobin model, 1968

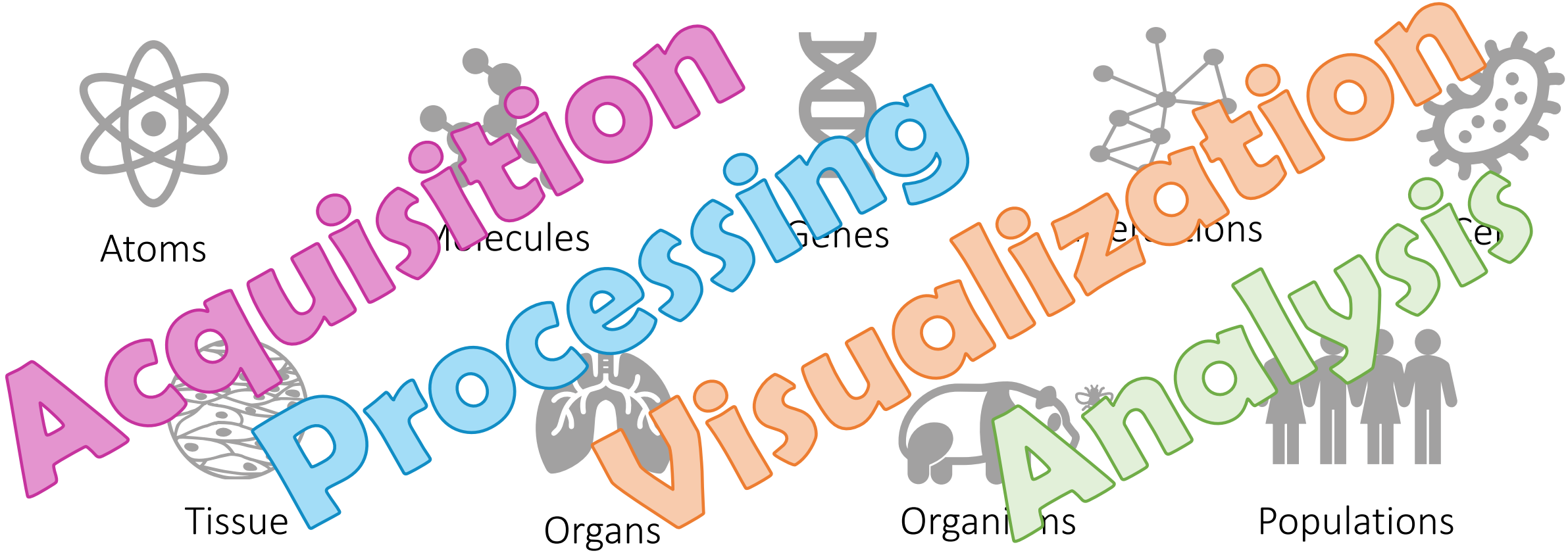

PROFILE




Glycolysis
Gly
SHMT
Ser
R5P
PPP
Pyruvate
Lactate
3-PGA
Acetyl CoA
PDH
PCB
Citrate
c-Aconitate
Aspartate
OAA
Malate
Krebs Cycle
Fumar
I.V.
Cancer
2D ¹H{¹³C}HSQC proj






Atoms
Molecules
Genes
Tissue
Organs
Organisms
Populations
Acquisition
Processing
Visualization
Analysis

Course Schedule

LV0 + 1	Kick-off Meeting & Chemistry/Biochemistry Basics	Tue, Oct 1	09.00-12.00
LV2	From Simple to Multivariate Data Analysis	Mon, Oct 7	11.00-14:00
LV3	Spectroscopy and Chemical Imaging	Tue, Oct 8	9.00-12.00
UE1	Analytical Chemistry	Oct 8 – Oct 18 (1.5 week)	
LV4	(Bio)Analytical Chemistry	Mon, Oct 14	11.00-14.00
LV5	Omics Technologies	Tue, Oct 15	9.00-12.00
UE2	Omics Data Analysis	Oct 18 – Oct 28 (1.5 week)	
LV6	Anatomy and Medical Imaging Acquisition	Mon, Oct 21	11.00-14.00
LV7	Medical Image Processing	Tue, Oct 22	9.00-12.00
LV8	Medical Image Segmentation	Mon, Oct 28	11.00-14.00
UE3	Image Processing	Oct 28 – Nov 7 (1.5 week)	
LV9	Volume Visualization	Tue, Oct 29	9.00-12.00
LV10	Public Health vs. Cohort Data Visualization	Mon, Nov 4	11.00-14.00
LV11	Machine Learning in Biomedical Applications	Tue, Nov 5	9.00-12.00
UE4	Medical Visualization	Nov 7 – Nov 18 (1.5 week)	
LV12	Data Science in Biomedical Applications	Mon, Nov 11	11.00-14.00
LV13	Visual Analytics: Part I	Mon, Nov 18	11.00-14.00
UE5	Machine Learning	Nov 18 – Nov 28 (1.5 week)	
LV14	Visual Analytics: Part II	Tue, Nov 19	9.00-12.00
LV15	Artificial Intelligence in Biomedical Applications	Tue, Nov 26	9.00-12.00
UE6	Visual Analytics	Nov 28 – Dec 9 (1.5 week)	
LV16	Visualization of Time-Oriented Data	Mon, Dec 2	11.00-14.00
LV17	AI Ethics in Healthcare	Tue, Dec 3	9.00-11.00
LV18	Invited Talks -- Part I	Mon, Dec 9	11.00-14.00
LV19	Invited Talks -- Part II	Tue, Dec 10	9.00-12.00
LV20	Excursion	Mon, Dec 16 ***or*** Tue, Dec 17	tbd
EX1	Oral Discussion of Assignments	Jan 13, 14, 20, 21	
EX2	Final Exam	Jan 27, 11.00-14.00	

All LVs will be done in this room, with the exception of LV19 (more info coming soon!)

Course Components

- LV1 – 17 : “Normal” lectures (3 x 45 mins each)
- LV18 – 19 : Invited talks from practitioners’ and data vis/analysis experts
- LV20 : Excursion *(details coming soon!)*
- 6 UE + Oral Discussion
- Exams

Course Components

- Lectures
  - Slides
  - Recordings (not guaranteed)
  - Readers
- Assignments
  - In groups of 3
  - Materials
  - 1.5 week of time
- Oral discussions
  - Appointments later on
  - Jan 13, 14, 20, 21
- Exams: Jan 27 **(in the PC lab)**

Everything will be on TUWEL (gradually)!

Grading

- Assignments:
  - 5 points each; 30 points in total for their submission
  - 10 points for the discussion of the assignments
  - 40% of your final grade

- Exams (Written – On TUWEL; 60% of your final grade)

- LV18 – 20 obligatory: missing them costs you points (each is -5 points)
- Active participation in LV18 – 19 means bonus points (up to +5 in total)

Grading Scheme

Grade	Points	Title	Explanation
1	89-100	Sehr gut	Outstanding performance with no or minor errors
2	76-88	Gut	Above-average standard but with some errors
3	63-75	Befriedigend	Average performance with notable errors
4	51-62	Genügend	Standard but with a significant number of errors
5	0-50	Nicht genügend	Failing grade